



National Implementation Vendor Engineering Standards

Version 2.0

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2 Purpose

The purpose of this document is to provide OSP Engineering Vendors with a single reference point to find all relative information for designing and drafting outside plant for CenturyLink National Implementation. This may contain links to other reference materials as needed.

3 General Information

3.1 General Design Information

All CenturyLink National projects will follow the same basic design requirements. This manual will provide some of the basic details that should be included on every project. Each area may have individual requirements in addition to those found here.

CenturyLink requires all Outside Plant designs (engineering/construction and final as-builts) to be created in an AutoCAD 2014 or Newer format using UTM83 coordinate systems in US Survey Foot units. CenturyLink has created design standards including blocks, line types, and plot styles that are to be used in every project. The standards will not only ensure consistency in our projects but are also time savers that will help with accuracy and legibility. All CenturyLink outside plant designs must utilize these standards. This is for engineering/construction prints and as well as final As-built.

CenturyLink standards need to be followed when creating prints. In addition, anything that is required by the permitting agencies must also be included. Anything not needed on the final as-built will be removed when creating the as-built.

Every drawing will in PaperSpace/ModelSpace format. The maximum number of tabs must not exceed 20 (excluding non-project sheet tabs). The Base will be in PaperSpace and on every tab that is needed All handholes must have configurations. All Manholes must have butterfly details where required by the OSPE. All Directional Bores must have profile details. All Project sheets must have HDPE configurations. All Project sheets where cable has been pulled must have cable information added. All Bridges must have bridge details.

Existing As-builts must be used when available. These will be provided by the CenturyLink National Records, GIS and Fiber Management (RGFM) Team. These prints will act as base drawing to design and create as-builts for a project. Engineering vendor is responsible for representing all underground utilities including the CenturyLink running line on the drawings provided.

Only the area of the project that is changing should be changed on the existing print. If no existing print exists, the engineering vendor must create new drawings using CenturyLink standards.

The Engineering/Construction Prints will be used to create the final as-builts

NOTE: This manual is not meant to cover every situation that may arise in the field. Discretion should be used when designing CenturyLink projects using best practices and industry standards. Requirements set forth by all governing authorities (having jurisdiction over the work that is taking place) should be met and included in the design as appropriate.

3.2 New Route Design

There are many items to consider when designing the route of a new CenturyLink fiber optic cable. When able, the engineer should explore the most cost effective, time efficient and secure route. Market planning and other potential opportunities and/or expansion in the area should be considered in order to place the fiber in the most beneficial location for future use. Consideration should also be taken around areas that have potential for road improvements due to developments in the area.

When designing a new route, the general practice is to build back to an existing access point in order to prevent additional loss in the route due to added splice locations. There may, however, be times where a new access point must be placed, and slack pulled from the nearest vault in order to create a new splice. Cost consideration and due diligence is necessary to ensure the design is consistent with network capabilities.

3.3 Aerial vs Underground

Underground design is the preferred method of placement for CenturyLink fiber optic cable. At times, there are locations where an aerial lead is required due to regional issues. Items to consider when determining the best method of placement include customer requirements, potential safety concerns, future growth in the area, recurring pole rental fees, maintenance costs, environmental concerns and make ready issues. The CenturyLink OSPE is required to use due diligence and consider all options before making the decision to build an aerial lead.

4 Basic Project Format

All design and engineering packages for placing new plant shall be completed using the CenturyLink provided AutoCAD blocks and standards. All external engineering/drafting design (including final as-builts as applicable) shall be delivered to CenturyLink in both a .dwg file and .pdf format.

Where existing CenturyLink plant is in place, projects may be drawn utilizing CenturyLink as builts. Final as-built drawings must be drawn on existing as-builts. In locations where there are no existing CenturyLink as-built drawings, CenturyLink will provide a baseline drawing for the engineering contractor to use. All drawings must be drawn to CenturyLink standards regardless of base file.

4.1 System Requirements

It is required to have drawing objects created and located geospatially. If you have a source of road/building vector data that is geospatially located (with UTM projection) in the AutoCAD DWG format, you can use these files. However, if you don't have this source, you can use live Bing aerial imagery, The Bing live data map doesn't travel with the drawing file (DWG), but the drawing objects and projection, are considered geospatially located, and do travel with the drawing. See AutoCAD setup document for the installation instructions. Need to get the vendor portal information for linkages.

All layers, linetypes, blocks, detail standards and programs that will be used to create drawings will be provided by the RGFM team. Any questions may be sent to askospdesign@centurylink.com.

4.2 Face Sheet

Every CenturyLink project must have a face sheet to identify the necessary details of the project at a glance. Each face sheet should have the following information:

4.2.1 Vicinity Map

The vicinity map of the face sheet should be a clear map that outlines the limits of the project. The map should have street names and arrows marking the beginning and end of the project. It should also include shadow boxes that show which project pages encompass which sections of the project.

4.2.2 Customer Contact Information

The customer contact information, if applicable, should be provided on the face sheet. This should include a name and a phone number whom the construction team can contact when ready to begin the project.

4.2.3 Building Management Information

The building management contact information, if applicable, should be provided on the face sheet. This should include a name and a phone number whom the construction team should contact before beginning work on the property.

4.2.4 Call Before You Dig Logo

Each face sheet must have a “Call Before You Dig” logo that should be located in the bottom right hand corner of the sheet. Approved versions and rules regarding the use of the 811 logos can be found at www.call811.com. The following is the logo used in most states:



4.3 Construction Units

Every CenturyLink project must include a list of the applicable construction units for that project. A list of the construction units and their descriptions can be obtained by contacting your CenturyLink representative. The contract design firm must be familiar with these units and when to use them. The unit list for each project must be reviewed by the CenturyLink OSPE during review of the design, before sending to construction.

4.4 Dimensions

Stationing is required on most CenturyLink projects. In the event it is not used, dimensioning should be on the project to provide a running line and/or location for the placement of facilities. Stationing marks along trench running line are at a minimum required at every bend in the conduit on either end of the manhole (access point), at every riser, utility markers, transitions between public and private ROW, and every 100'. Aerial plant will require stationing at every pole where strand is attached to support the project (including overhead guys). These requirements are at a minimum.

ROW and/or Easement dimensions should also be provided on every CenturyLink project where facilities are to be placed in the ROW or Easement. This is especially important if the same project prints used for placing are also utilized to gain the appropriate permit. Showing these dimensions on the project gives the construction contractor a clear idea of where they need to be and helps eliminate accidental placement on private property.

Use one baseline for offsets and stationing, example: the centerline of a road, the edge of a road or one track Your baseline must be something that is visible and stationary. Edge of property line or right of way is not acceptable since it is not a visible reference. (See Engineering and As-built Handbooks for more details)

Drawings should line up sheet to sheet at the match lines.

Right of Way should be added to all project sheets with Dimensions but it should never be used as a baseline.

Standard Scale

It is recommended the maximum standard scale on 11x17 paper to be used for underground is 1" = 50', Intercity/aerial is 1"=100'.

4.5 Layers, Blocks and Line types

CenturyLink will provide all blocks and line types that are to be used. CenturyLink will also provide the layer set up and the standards for what will reside on each layer.

These items should be used as much as possible when creating or working on the engineering/Construction prints. Anything not created per the standards will have to be changed to reflect the standards on the final as-built.

4.6 Running Line

The location of underground fiber in the ROW or easement is very important. Be sure to design the running line as far back in the ROW as possible to avoid possible forced relocations in the future. This also allows for less damage from other utilities that are placed in the ROW. Keep running line changes to a minimum. If the cable meanders back and forth in the ROW, it has a much higher chance of being damaged during placement of other utilities in the ROW.

Clearly mark the running line of the cable on the project drawings using offset measurements as appropriate. Severe running line changes that are needed once construction has begun should be discussed before placement to ensure the fiber will still be in the ROW or easement and that the changes are necessary.

There are standard clearances from other utilities that should be maintained when placing underground fiber optic cable. Please check the local and state requirements for your area to determine proper clearances.

4.7 Building Access

The objective of the BEA Drawings is to provide the landlord with visual depictions and scope of what CenturyLink intends to install in their building.

The scope of work should outline when these are required and if they must be certified, if scope doesn't state certified drawings are required then work can be self-performed if preferred.

The elements to be included in the drawings are:

- The locations where CenturyLink intends to enter the private property.
- The building entrance link(s) – depiction of existing and proposed new entrance infrastructure and method of installation: trenching, boring, size of conduit, etc. Note: Underground building penetrations will be made with steel sleeves, or as mandated by building engineer, and shall never compromise the architectural structure of the building.
- Equipment and Facilities to be placed in the MPOE.
- Risers to be utilized – existing and/or new installation.
- Equipment room where CenturyLink equipment is to be installed with space dimensions of the Equipment Room and Equipment footprint.
- Power needs and source to be identified and depicted.
- Pathways utilized inside the building connecting MPOE to equipment spaces and facilities demarks – existing and/or new pathways to be installed.
- Any additional facilities to be installed on the subject property that complete the full scope of the build (OSP and ISP elements).
- The level of detail contained in the drawings is dependent upon the individual landlord's requirements necessary in order to obtain approval to close a BAA. The minimum requirement is an excel General Depiction drawings incorporating elements described above.
- When required by landlord, Detailed Engineering drawings most typically produced by construction.

4.8 Common Dmarc

This section is meant to reference the design criterion for Common Dmarcs deployed throughout the network. In some scenarios, a Collector Node will be deployed as an aggregation point for several Common Dmarcs. A collector node may also be used as a fiber distribution point to aggregate traffic. The specifications for the Collector Node will have minor variations as stipulated below or by the individual scope of work.

- **Common Dmarc** – a Point-of-Presence located within a building that is intended to serve all potential customers within the building via electronic solution or dark fiber extension. A Distribution POP will typically be served via a single lateral and should be ideally be centrally located in a dedicated or common area of the building. Common Dmarc layout models will vary depending on prospective customer base, space availability and availability of suitable power within the building.
- **Collector Node** – a Point-of-Presence in a building that will be used to serve customers in a cluster of buildings via transport equipment or dark fiber extension. A Collector Node will typically be served via diverse laterals and contain at least 3 racks and will typically require provisions for access to emergency generator power or an umbilical for a roll-up generator.

4.9 ISP Construction Guidelines

Selection of Distribution POP space

This section shall govern all new building adds (including single tenant buildings - understanding that single tenant buildings can be subdivided into multi-tenant buildings in the future) and for existing sites that require an augment to be brought up to these standards.

When deploying into a building, the preferred location for the CenturyLink Distribution POP is to be on the same level as the MPOE. Either a dedicated or common area space is acceptable. If the building is located within a flood plain, then consideration should be given to the floor level such that the CenturyLink Distribution POP is located above anticipated flood levels.

Space selection for the Distribution POP will be at the discretion of the GFS Field Planner with input from the OSPE and Metro Planner and will typically be identified during the initial site survey. Consideration for prospective customer base, space availability within the building and availability of suitable power will be primary contributing factors in DistroPOP space determination. Refer to the [Typical Distro POP Models.doc](#) for standard models:

There may be circumstances where specific site requirements exceed the Typical Distro POP Models.doc specifications and those will be identified on a case-by-case basis. Ideally, the space should be secured by a lockable door or caged area. If a common area is to be used, then locking cabinets may be deployed in lieu of a caged area.

Heat loading from the rectifier and telecom equipment needs to be taken into consideration, and the chosen space should have adequate ventilation. House cooling is the preferred method for cooling of the space. Supplemental cooling is not planned as a part of these Distribution POP's; however, consideration should be given to determine if the planned space will be at risk for exceeding the alarming thresholds for equipment (50°F to 100°F). In instances where there is concern for potential temperature thresholds being exceeded, Network Planning will evaluate the appropriate supplemental requirements.

A floor load capacity rated at a minimum of 100+ lbs. per square foot is required.

Riser System

Typically, only a fiber optic riser system will be constructed in multi-tenant buildings. All installations should follow CenturyLink standards, local building codes and building requirements. Copper or coaxial facilities will only be used as part of a specific approved business case.

Riser cabling should be designed to the specifics of the building and the prospective customer base. The distribution riser cable should be appropriately sized depending upon the number of prospective tenants to be served with the guideline of 6 fibers per prospective tenant, and a minimum fiber cable count of 48. If no tenant information is available, the riser is to be designed with 4 fibers per floor. If the Distribution POP is to be located on an upper floor, the riser should be appropriately sized as listed above for distribution to tenants, plus 24 fibers to serve the POP. Consideration of the planned riser conduit sizing should also be considered when sizing the distribution riser cable (i.e. if the conduit size will only allow a single fiber cable - oversizing the distribution riser cable would be appropriate).

The riser system should be designed to integrate seamlessly with the existing building riser system and not interfere by obstructing any pathways. Any FDP's or splice cases need to be out of the way of existing or future riser cables/conduits.

A small coil shall be placed on every third floor to be available to serve customers one floor above, below, or on the same floor. The density of the coil should be a minimum of 50 feet and not to exceed 100 feet to provide appropriate slack for the adjacent floors.

In buildings that utilize a rigid conduit, CenturyLink will deploy conduit that is properly sized to pull the appropriately sized fiber through without friction. All junction boxes shall be NEMA1 rated.

When using a Corning FlexNap solution, it is recommended that a 4 fiber/floor solution is implemented to serve a typical multi-story building. However, the tenant density and potential bandwidth demands should be evaluated to determine if a 6, 8, or 12 fiber/floor solution is required. In such cases, the FlexNap taps shall be placed at three-floor spacing (in a four fiber per floor solution, each tap would be a 12-fiber tap).

In instances where the Distribution POP is located on a floor above the basement or MPOE level, construction of a parallel integrated distribution riser should be designed and constructed at the time of the Distribution POP.

5 Underground Construction

5.1 Handhole/Manhole/Vault (Access Point) Locations

It is strongly recommended that an Access Point be placed along a metro cable route at least every 1000' to allow for easier cable placement and access. For Intercity applications the minimum access point placement is 5280'. It is recommended that no more than 270 degrees worth of bend radius be allowed before placing an access point, however, the design should never exceed the manufacturer's recommended pulling tension. There should also be an Access Point located on both sides of any major crossings such as RR, Interstate, Waterway, and in locations where future access to the cable is anticipated.

Consideration should be given to items such as future needs, major water crossings, highways, RR's, multi-tenant buildings, ingress/egress, future road projects, and riser locations, just to name a few. In building applications, Access Points should be placed in a location that allows for easy access while taking into consideration potential impacts to building tenants and aesthetics. For slack storage in Access Points, please see the "Slack Storage" information contained in these standards.

It is recommended when placing a new Access Point that is a splice location, an 8' 5/8" ground rod with #6 copper wire attached and coiled in the vault should be shown on the design.

Where appropriate, access point installation should include the placement of the racking and follow the manufacturer's recommended placement guidelines and load requirements.

5.2 Conduits

CenturyLink does not direct bury fiber. All underground fiber must be placed in a duct in accordance with the CenturyLink Construction standards or the governing permitting authority requirements, whichever is greater. CenturyLink utilizes primarily Orange, Green, Blue or Black conduit. The minimum depth for Metro fiber is 36"; however, the local permitting authority requirements prevail. For building applications, the fiber must be placed in the appropriate rated duct per the NEC or the local building code, whichever is more stringent, for the environment.

When designing conduit, the appropriate number of conduits must be designed to be sufficient for growth in the area and the cable being placed. Ideally you should be considering conduit placement for at a minimum, the next 20 years. Details such as forecasted growth, market opportunity as well as cost, length and difficulty of placement should be measured.

For backbone a minimum of 2-1.5" conduit pathways or sufficiently sized conduit for the growth in the area, shall be included in the design.

For intercity design consideration should be given to future growth and existing cross-sections of conduit; however, a minimum of 3 – 1.5" conduit pathways or equivalent should be included in the design.

For customer laterals, a minimum of 2-1.5" or equivalent conduit pathway should be included in the design if not using existing customer owned duct.

All CenturyLink conduits shall terminate directly into manholes, handholes, vaults, buildings or stubbed up a pole into a u-guard, per the CenturyLink Construction Standards.

5.3 Method of Placement

It is the responsibility of the CenturyLink OSPE to determine the best and most cost-efficient method of placement for a project. The most common methods for placing underground fiber are directional bore, trenching and plowing. Micro-trenching is also used albeit rarely. The feasibility of the placement along with consideration of field conditions must be reviewed in the determination.

5.4 Crossings

Whenever possible major crossings such as interstate, waterway or RR should be avoided due to the cost of placement, permitting fees, and difficulty of placement. Future maintenance, congestion of the ROW and future relocation requirements are also a concern. In the instance where it is not possible to avoid these crossings, the CenturyLink OSPE should research the permitting authority requirements on depth, distance, and fees associated with such crossings in order to determine the most safe and economical design possible. The OSPE may also reach out to the regional **Implementation Services 3rd Party Fiber and Right of Way Contract Acquisitions** regional manager for assistance with the due diligence.

5.5 Slack Storage

When designing a new underground fiber route, sufficient slack must be placed in strategic locations to best optimize the use of the cable for future needs. The minimum requirement for metro cable is 100' slack located every 1000' and in access points that could be utilized to serve future businesses.

For Intercity, the minimum requirement is 100' slack loop at every access point.

When designing slack, the amount needed may depend on the location of the loop. For instance, if the splicing truck cannot park directly adjacent to the access point where the slack is stored, additional slack may be needed so the loop can be pulled into the splicing vehicle.

There should also be sufficient slack storage at the dmarc location of a building to allow for splicing. A minimum of 65' is recommended.

5.6 Locate Wire

All CenturyLink underground cable must be locatable. This can be done in a couple of diverse ways. If the cable is dielectric, a locate wire must be placed. If the cable is armored, a locate wire is not required as long as the integrity of the cable is maintained.

In areas where a di-electric cable will be placed in a newly placed duct or in situations where duct only is being placed, the design should include placement of a continuous #10 AWG locate wire in the trench or bore hole to be terminated to a ground lug in the access point or at an above ground marker post or in a pedestal if allowed by the permitting authority.

If placing di-electric cable into an existing duct, the locate wire should be pulled into the conduit with the cable. The locate wire must be terminated to a ground lug as per above paragraph.

5.7 Locate Management System

A location management system is a system that provides continuous signal using a remotely controlled transmitter housed in a Central Office or other centralized location. Tone on individual routes can be turned off and on remotely via phone

Permanent tone should be provided on all intercity backbone and where appropriate on intracity backbone routes. Grounding units with surge protection to be used at all OSP splicing locations. Laterals will be designed to be located via portable tone generation as a rule. Side leg bonding should only be done in special situations as warranted by unique circumstances where portable tone generation isn't an option and backbone tone will not be impeded.

Rack mounted units are preferred for generation of permanent tone. Tone generators should be spaced among sites for maximum efficiency in a leap frog configuration. Tone generators to be specified with the proper channel capacity for sufficient coverage of more than two cables in sites with more than two backbone terminations

6 BRIDGE AND FIXED STRUCTURE ATTACHMENTS

6.1 General

This practice describes methods for the placement of CenturyLink conduit and fiber optic cable onto bridges and fixed structures. In this context, a fixed structure is defined as a tunnel, wall or other permanent surface to which CenturyLink will attach conduits, cables, devices or support structures.

6.2 Design Guidelines

The following factors must be considered before designing bridge or structure attachments:

- Acceptable engineering techniques
- Accessibility for construction
- Aesthetics
- Alternative routes
- Economics
- Environmental considerations

-
- Ownership
 - Permitting agencies and requirements
 - Security
 - Structure building materials
 - Type of structure
 - Worker safety

All bridge and structure attachments will be considered and designed individually. There is no single standard type of bridge or structure attachment. Each situation is unique, and each attachment must be engineered with a particular bridge or structure in mind. However, bracket types and associated hardware should be limited to CenturyLink standard designs when possible. Non-standard bracket designs and associated hardware must be submitted to the appropriate CenturyLink representative for written approval prior to incorporation into an engineering design.

The design engineer is required to obtain copies of all available bridge drawings from the permitting agency / structure owner. The design of bridge attachments shall minimize bends and to the greatest possible extent shall maintain a horizontally and vertically straight conduit alignment. If there are expansion joints in the bridge design, a conduit coupler that allows for expansion or an attachment that allows for conduit movement should be utilized.

Due care and consideration will be given to future bridge construction, relocation, maintenance and the impact on the conduit system.

Bridge attachments will be placed as high on the structure as practical, but always above the bottom of the bridge.

If future bridge reconstruction and/or maintenance is anticipated, consideration should be given to the possibility of using split GSP, slotted GSP or split GSP collars and to storing extra cable in adjacent handholes.

CenturyLink approved conduit materials for attachment to bridges and fixed structures are:

- Galvanized Rigid Conduit (GRC)
- Split or Slotted Galvanized Steel Pipe (SPGSP)
- Bullet Resistant Fiberglass (with CenturyLink approval)
- High Density Polyethylene (HDPE)

Generally, head walls may be core bored if required. However, the core bore must not cut any rebar. The core bore must be sleeved with Schedule 40 GSP/GRC and concrete grouted. Link Seal inserts may be used in lieu of GSP/GRC and grout, if approved by the owner of the structure.

Conduit will not be attached to draw, swing or other type of movable bridges or structures. Conduit will not be attached to wooden bridges or structures unless no alternative placement method is available. Approval for attachment to wooden bridges or structures must be obtained in writing from the appropriate CenturyLink representative and the structure owner.

Handholes will be placed at both ends of bridges at which locations a transition from the conduit used to cross the bridge to HDPE will be made.

All casings will be equipped with a minimum of three corrugated innerducts. When designing conduit, the appropriate number of conduits must be designed to be sufficient for growth in the area and the cable being placed. Ideally you should be considering conduit placement for a minimum the next 20 years. Details such as forecasted growth, market opportunity as well as cost, length and difficulty of placement should be measured.

All attachment brackets will be hot-dipped galvanized. Attachment brackets will be placed to adequately support the conduit structure. A general guideline would be attachment at optimum intervals of ten feet (10'). Bracket spacing to fifteen feet (15') may be allowed in special cases.

Design must also include vibration-dampening materials for easing vibration stress caused by rail or road traffic. Neoprene insulators or equivalent will have a minimum of one-quarter inch (1/4") thickness. When embedding bracket studs in concrete, an epoxy cartridge will be used. Welding to a metal bridge or structure is not allowed unless otherwise approved in writing by the appropriate CenturyLink representative and the permitting agency / structure owner.

All nuts (top cone lock-nuts, side-lock nuts or equivalent), bolts and lock washers will be of stainless steel or hot-dipped galvanized design. A length equal to one diameter of the bolt will be exposed after nut is in place.

The design engineer is required to obtain copies of all available bridge drawings from the permitting agency / structure owner. The design of bridge attachments shall minimize bends and to the greatest possible extent shall maintain a horizontally and vertically straight conduit alignment. If there are expansion joints in the bridge design, a conduit coupler that allows for expansion or an attachment that allows for conduit movement should be utilized.

Due care and consideration will be given to future bridge construction, relocation, maintenance and the impact on the conduit system.

Bridge attachments will be placed as high on the structure as practical, but always above the bottom of the bridge.

If future bridge reconstruction and/or maintenance is anticipated, consideration should be given to the possibility of using split GSP, slotted GSP or split GSP collars and to storing extra cable in adjacent handholes.

6.3 Drawing Requirements

Drawing requirements for bridge crossings will be dictated by the permitting authority but at a minimum will require three views: plan, profile and cross section.

Bridge drawing will be incorporated into the construction drawings. Bridge and construction drawings will be properly cross-referenced.

Drawings will reflect each section of structural changes, with a cross section for each structural change.

Drawings will also include the following:

- Method of attachment and attachment bracket details, location and spacing with all appropriate measurements and manufacturing notations that may be required

- All appropriate handhole and pull box locations and conduit, sweeps and riser details
- The location of all expansion joints, which should be placed at the same location as the bridge expansion joint and have a capacity to expand and contract greater than, or equal to, that of the bridge's joint
- Tie-down measurements for conduit placement
- Any special construction requirements and/or restrictions
- Attachment bracket details for each bridge and will be of sufficient detail for fabrication.
- All nut and bolt specifications
- Complete materials list
- All core borings
- References to milepost locations, railroad bridge numbers and construction drawing sheet numbers
- Directional arrows and north arrow
- Pertinent permitting information and contact numbers
- All appropriate road, railroad, stream, river and/or creek names and direction of flow
- Special construction materials, conduit size, conduit type and innerduct specifications
- The height of the bridge above the road or water will be shown to the bottom and top of the bridge structure
- If the bridge is over water, the depths of the water will be indicated
- Single or multiple duct placement and note the ducts occupied by CenturyLink

Bridge drawing will be incorporated into the construction drawings. Bridge and construction drawings will be properly cross-referenced.

7 Aerial Design

CenturyLink's preferred method of cable placement is underground. At times it may be a requirement to place aerial cable instead of underground due to extenuating circumstances. Condition of poles, recurring fees, number of attachments, clearance and safety concerns must all be taken into account when considering aerial placement.

7.1 Pole Attachments

At times, it may be more cost efficient to attach to existing poles owned by other utilities than it is to place cable underground or build a new pole lead. Consideration of recurring pole rental fees, number of utilities already on the pole line, anchor and down guy requirements, clearance issues, and potential make ready requirements should be considered when attaching to a pole not owned by CenturyLink. The OSPE may also reach out to the National Implementation Services 3rd Party Fiber and ROW Contract Acquisition Team regional manager for assistance with the due diligence needed to determine use of the identified poles.

The pole provider's engineering guidelines may change upon attachment submittal to the pole owner. This will serve as the OSPE's notice of engineering requirements. These engineering changes will need to be adhered to and design changes made.

7.2 Tagging

When placing cable in an aerial environment, it is a requirement to tag the cable. Cable will have a 4" to 6" slack loop and fiber warning tag at every pole and at every building entry. Many pole owners require specific colored tags for each utility that attaches to their poles. Be sure to check with the pole owner for their specific requirements and note the drawings accordingly.

When placing a CenturyLink pole, the pole must be tagged with the unique ID that matches the fiber inventory system.

7.3 Stand Size, Grounding, Down Guys

Strand - Minimum 6.6M 1/4 EHS. (or greater as required by CenturyLink, pole owner, or permitting agency)

At a minimum, Strand will be grounded at ¼ mile intervals with #6 copper wire bonded to power company MGN/MGNV (if permissible) or to a 10-foot long copper clad ¾" ground rod.

New anchors shall be ¾" (minimum) when required and shall be noted on the engineering drawings.

Slack spans may be utilized when necessary but should be kept at a minimum and only when the sag will not exceed the minimum clearance requirements

All corner poles will be guyed where the change in direction exceeds 4'.

7.4 Clearance

Aerial plant clearance requirements are based on the National Electric Safety Code (N.E.S.C.) and shall meet all requirements of the governing authority.

The cable is classified as a fiber optic supply cable as described in the N.E.S.C...

7.5 Anchors

Down guys and anchors are to be utilized at the end or beginning of an aerial lead and at every location where there is a directional change greater than 4' or as required to maintain the structural integrity of the pole lead. There are several types of anchors to choose from. The scenario, type of soil, and weight of cable determine the most applicable material to use.

7.6 Make Ready

A make ready is when existing attaches on a pole need to move in order to make room for another utility to attach to the pole and maintain proper clearance.

When designing aerial cable, make ready work should be identified early in the process and the requests submitted as soon as possible due to the lead time the work generally takes to get completed.

7.7 ADSS

ADSS or self-supporting cable should only be used in situations where the specific requirements warrant it. An example would be a short section into a building where there is no way to place strand. When placing ADSS cable, adherence to the ADSS standards from the cable manufacturer is required.

7.8 Wind Loading

In many areas wind loading calculations are required to request a pole attachment, or to add to an existing one. There are several wind loading calculation software applications that may be used for this. It is a requirement that the OSP Engineering vendor be familiar with the wind loading specifications and requirements for their area. When designing aerial projects, it is a requirement that the engineering vendor provide the OCALC documentation with the design package. This information must be stored with the rest of the drawing package for future reference if needed.

7.9 Aerial Conduits

Aerial conduits are used in situations where additional protection is required for the fiber cable or where we may need to pull an additional cable over a difficult aerial crossing. It can also be beneficial where scheduling difficulties in new cable placement require the crossing to be done at a different time than the overall construction.

Some examples of areas where an aerial conduit might be helpful include areas of heavy vegetation, highway, RR, or water crossings and areas where we have severe pest issues. The recommended size for an aerial duct is a minimum of 1 ½" HDPE type conduit. You must verify that the governing authority of both the crossing and pole owner will allow use of the conduit. Aerial duct type, span loading and anchors must be called out in the design.

7.10 Slack storage

When designing an aerial fiber route, sufficient slack must be placed in strategic locations to best optimize the use of the cable for future needs. The minimum requirement is 150' slack located every 1500' and locations that could be utilized to serve future businesses. Slack storage must be stored in snow shoes. When designing slack, the amount needed may depend on the location of the loop. For instance, if the splicing truck cannot park directly adjacent to the pole where the slack is stored, additional slack may be needed so the loop can be pulled into the splicing vehicle.

8 Fiber

8.1 Fiber Cable

Standard Cable Type is (SMF28 ELL) single mode, single armor, single jacket, loose tube is the standard for most underground and aerial applications. Standardize on the sizes. In some instances, it is acceptable to use an all dielectric design if the cable will be in a highly conductive environment such as leasing a duct from a power company or if the cable is utilized as a building entry cable. It is also acceptable to use an indoor-outdoor cable for building entries or a riser rated or plenum cable for interior building applications.

8.1.1 Matching Fiber Types

When splicing OSP cable, every effort should be made to match like for like fiber types to avoid core size mismatch at the splice point. Spliced fiber spans with mismatched cores have been found to restrict wavelength capacity on DWDM systems deployed within the network resulting in costly remediation. For this reason, all planned projects (non-outage related) shall match like for like fiber cable types, where possible, to the existing fiber it will be spliced to. Example: True Wave to True Wave, All wave to All wave and Ultra to Ultra.

Where matching like for like fiber type is not possible, such as product availability or inherent route design, fiber cable type selection shall match as closely as possible to the existing fiber's Chromatic Dispersion (CD) characteristics and core size to reduce the effects of core size mismatch. There are a number of dissimilar fiber types with matching core sizes that will differ by CD coefficient. First consideration should be made to match core size and secondly to match as closely as possible the CD coefficient. Newer Corning Ultra and Ultra Low Los fiber have a unique Mode Field Diameter that make the core size appear extremely large when viewed unidirectionally. For this reason, in the unlikely event dissimilar fiber type must be spliced into existing Ultra or Ultra Low Loss fiber, then ONLY SMF28 or Allwave should be considered. When dissimilar fiber types are spliced, it is critical fiber testing is completed and results are reviewed and accepted by the FQA team (Fiber Quality Assurance team) prior to commissioning. Follow the [L5 Methods and Procedures Fiber Testing and Acceptance Process](#).

Exception shall be made for emergency restoration where immediate repair is needed, and available fiber type is limited. In these circumstances it is permissible to temporarily splice dissimilar fiber types with the understanding the permanent solution will replace the cable with one of matching or closely matching specifications.

8.2 Fiber Sizing

8.2.1 Building Laterals

When designing a building entry project, the cable should be sized with sufficient spare fibers to allow for growth along the given route to the building. While the minimum cable size for a lateral to a building is a 24-count fiber, consideration should be given to the requirements of the building, both long and short term. For instance, larger buildings or campus environments may require a higher count fiber based on their future needs. Long laterals with potential for future customers along the route, should be considered a backbone extension and the appropriate size fiber should be used.

8.2.2 High Capacity Buildings

When designing high capacity buildings such as data centers, stadiums, and high-rise buildings, the cable should be sized with sufficient spare fiber to allow growth to the building. The minimum cable size for one of these types of high-capacity buildings is a 48-count fiber. The OSPE should consider the size and potential customer capacity of the building when designing the fiber to ensure future needs will be met.

8.2.3 Metro Backbone

For backbone design, the cable should be designed utilizing growth potential in the area combined with scalability and cost efficiency. For instance, if you are planning to build backbone in a downtown area where the construction will be costly and difficult, it may be a good idea to scale the cable up to eliminate the need for a larger cable in the near future. Care should be taken to place the cable along a route that will provide CenturyLink with the most opportunity. The minimum standard for backbone size is a 288-count fiber optic cable for many areas.

9 Intercity

New intercity, formally known as long haul fiber, is built infrequently. However, you may run across the need to replace or utilize intercity fiber or conduit.

9.1 Intercity Fiber Builds

For any new Intercity fiber builds, the current cable standard is a 288 Hybrid with 240 fibers SMF-28 Ultra Max, and 48 SMF-28 Ultra Low Loss, however, a cost study should be completed to determine the best option for the cable and conduit depending on what is needed for your specific project. Minimum conduit placement for a new Intercity fiber build is 3-11/2" innerducts placed at a minimum depth of 36". In some cases, it may be prudent to place more or less depending on the size of fiber being placed, location, and expectation of future needs. It may also make better sense to place a larger size duct, such as 2", to accommodate a larger fiber size. For the last span into a metro market – a consideration should be made to upsize the cable for metro consumption from the Gateway to the 1st ILA on the span. (i.e. a 288 ct could be upsized to a 432 ct with 289-432 being made available for metro consumption)

9.2 Replacement

As a rule, when replacing Intercity Fiber and conduit, short sections less than 2 miles should be replaced like for like. For longer replacements or high cost builds, a feasibility study should be conducted to determine the best option for cable and conduit size. Each situation should be studied for best solution and design based on requirements of the company. The Transport & Infrastructure planning and product teams will provide the final approval for intercity fiber and conduit replacement if not using a like for like replacement.

10 Permitting Specifications

It is the CenturyLink vendor's responsibility to research the ROW, understand the permitting requirements, and create a drawing that can be utilized to secure the permit as well as construct the project. This includes but is not limited to:

- Examine and search public records to determine land ownership, including the names and addresses of surface owners, tenants, renters, mortgages, liens, etc. Prepare abstract and title reports sufficient to comply with CenturyLink's requirements and perform title curatives as may be requested by CenturyLink.
- Prepare all types of land related documents in a form acceptable to CenturyLink. Such documents shall include, but not necessarily be limited to: leases, easements, deeds, permits, options, consents, assignments, letter agreements, releases and amendments. Contractor shall also be responsible for furnishing information necessary to prepare said land-related documents.
- Negotiate, acquire, settle and deliver to CenturyLink all types of land related documents as described in the above paragraph, properly executed and in a form acceptable to CenturyLink.

- Perform those functions customary to the administration of a land office, including but not necessarily limited to: maintaining fee properties (encroachments, granting of easements, sale and acquisition); conducting facility assessment and due diligence for asset sales/acquisitions and spindowns; providing supervision of land personnel and coordinating staffing needs; establishing and maintaining favorable public relations with landowners and governmental agencies; assisting operation crews for construction and maintenance related work; managing easements and leases; providing payment of rights; handling permitting, zoning franchise issues and assisting in easement/lease encroachments. Provide support on the need for authorizations for work in or near Waters of the United States. The performance of these functions shall be in a manner acceptable to CenturyLink
- Provide support and give testimony in matters of litigation when require by CenturyLink.
- When necessary and mutually agreed upon between CenturyLink and the vendor, permit and assist in the coordination of land and environmental related surveys.
- Perform liaison role during permitting, acquisition, construction and maintenance activities on behalf of CenturyLink and between contractors, landowners, tenants, governmental agencies and CenturyLink.
- Provide land-related input to CenturyLink during the conception, evaluation, planning and implementation phases of projects.
- Provide all other related assistance as requested by CenturyLink to accomplish necessary work generated by and through CenturyLink

11 Redlines

Either the Engineering inspector or the construction vendor will document how, what and where plant is being placed. CenturyLink will provide sequential blocks on the drawings for construction to fill out the information during the redline creation. In situations where the drawings become too cluttered, a standard blank cable pull sheet will be provided as part of the project drawings.

All Manhole/Handhole need to have a LAT/LONG and a MH/HH verification form filled out if requested by the CenturyLink OSPE

12 As Builts

In situations where you are provided with drawings that have existing items not related to the placement of new, please do not remove these items from the drawings. You may update them as necessary from the redlines. New stations will be added for all running line information – Manhole, handhole, bores, R/L changes, etc.

All beginning and ending of Bores must have depths in the callouts. Depths must also be on any running line object that was place at a different depth than the standard 36". All road and track information will remain on the drawing unless noted on redline to correct. Baseline will remain the same as it was on the engineering print Markers are to be place at correct station and marker numbers added on the prints.

12.1 Directional Boring Requirements

A bore log must be provided by the construction contractor every 20' feet. In addition, a bore profile must be provided for every road, structure, waterway or railroad crossing. In addition, a bore profile must also be provided for utility crossings in congested areas or in situations where we are closer than 24" from the nearest utility. These logs and profiles must be converted into the as built drawings.

12.2 Cable

The following cable information must be included on the final as-builts using the CenturyLink provided blocks.

- Cable type
- Fiber Count
- Manufacture
- Reel Number
- Sequentials at slack, splice, buildings and pull thru points

13 Version History

The latest version of this document can be found at: https://portals.level3.com/sites/GFS/DocumentStore/L5UG_National_Implementation_Vendor_Engineering_Standards.docx

Electronic copies in any location other than the above website, and all printed copies, are uncontrolled.

Version	Date Published	SMEs	Sponsor	Summary of Changes	Writer(s)
1.0	6/26/18	Joe Meissner, Rick Cook, Gabe Schnelle, Gary Pace, Heather Seabury, Bill Chandler, Nancy Servantez, Bruce Carney, Rick Jurosky, John Nagel, Jon Ellingson	Jeff Polachek	First Release	Veronica McClinton
2.0	5/28/19	Rodney Kinnett, Darrell Smith, Rick Spencer, Erica Stockford	Rob Ward	Added section on matching fiber types	Erica Stockford